lower half of venation ochraceous, the upper half black. Head (including eyes) considerably broader than base of mesonotum; eyes protuberant, moderately stylate; length of head about half its width between eyes and almost as long as pronotum, the lateral angles of which are rounded; basal areas of cruciform elevation strongly obliquely striate; opercula transverse, not passing base of abdomen; anterior femora strongly spined beneath.

Long., excl. tegm., ♂ 43 mm.; exp. tegm. 127 mm.

Hab. Central Brazil: Chapada, 2600 feet (*A. Robert*, Brit. Mus.).

XXXVII.—*The Changes and Variations in the Position of the Pectoral Fin during Development.* By H. H. Swinnerton, D.Sc., University College, Nottingham.

For some time I have been investigating the development of the Teleostean pectoral fin skeleton *. This has brought into my hands an extensive series of developmental stages of the three-spined stickleback (*Gasterosteus aculeatus*). Being struck by the difference in the relative positions of the fin in the youngest and oldest stages, I measured numerous specimens of all ages, with a view to ascertaining definitely if this indicated a real shifting during development.

The investigation above referred to brings out the fact that the glenoid border tends to rotate from a horizontal to a vertical position during development. This rotation is around the ventral end of the border. Consequently this point seemed the most suitable one from which to take measurements. Two were taken in each case, viz. from this point to the tip of the snout and to the hinder extremity of the notochord.

In fig. 1 (p. 320) the vertical line represents the distance of the pectoral fin from the tip of the snout, the horizontal that from the extremity of the notochord. The oblique lines give the average position of the fin at various stages. To obtain these the specimens were put together into groups containing individuals differing in length only 1 mm., and the average was found for each group. Gaps are left because the material proved insufficient to give trustworthy results at these points.

The shortest line represents the average position of the fin

* My thanks are due to the Government Grant Committee for aid in carrying on this investigation.

for 97 individuals varying in length from 4·5 to 6·5 mm. and in age from the time of hatching to the end of the third week. This is prolonged by a dotted line, to give an idea of the course it would have taken had there been no translocation later.

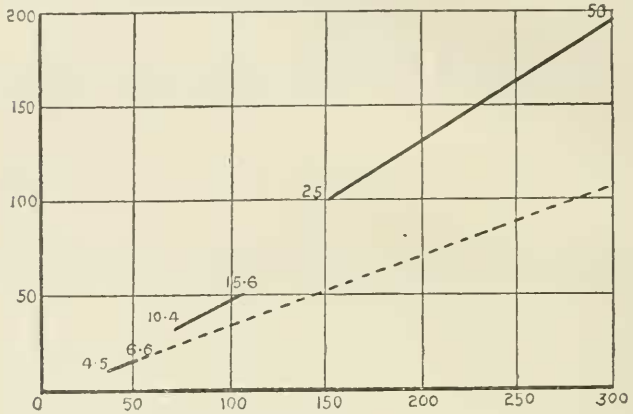

Fig. 1.

The next line represents the average position of the fin for 198 individuals varying in length from 10·4 to 15·6 mm. The age of these cannot be definitely stated, because they were not reared in the aquarium and individuals of the same age vary so greatly after the first month*. The position of this line relative to the dotted line and its increasing divergence from it show that the fin has shifted backwards and is continuing to shift.

The longest line represents the average position for 211 individuals varying in length from 25 to 50 mm., and exhibits the same facts more markedly.

Figs. 2, 3, and 4 were made from measurements of individuals varying in size from 4 to 7, 10 to 16, and 25 to 50 mm. respectively. The horizontal line represents the distance from fin to snout expressed as a percentage of the total length of the body. The vertical lines give the number of individuals with the corresponding percentage. From these it is seen that the maximum number have their fins 23 per cent. from the snout in the first group, 33 per cent. in the second,

* For example, of the two oldest specimens which I hatched and kept in the same aquarium for thirty-three days, one measured 10·8 mm. and the other only 6·4 mm.

and 39 per cent. in the last. Judging by these maxima, therefore, there is a total translocation of 16 per cent. of the length of the body. It is interesting to note that if the fifty smallest sticklebacks are taken the maximum falls upon the 22 per cent. line.

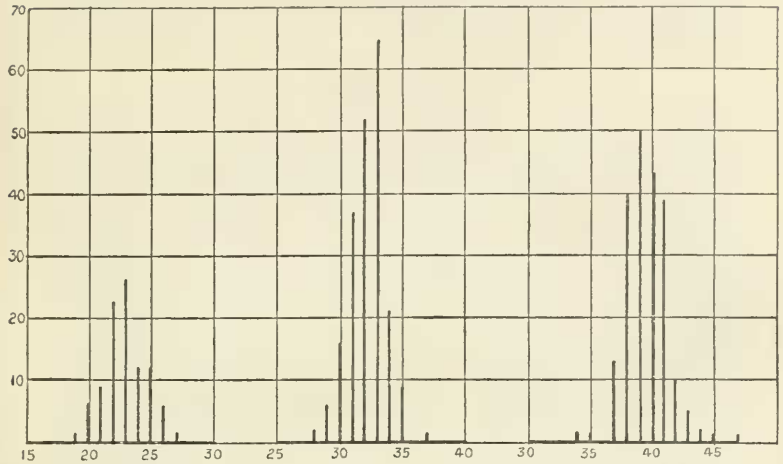

Fig. 2. Fig. 3. Fig. 4.

The immediate cause of the shifting of the fin is to be found in the fact that the coraco-scapular plate is at first a very insignificant portion of the pectoral skeleton, but as development advances it broadens out antero-posteriorly.

The ultimate cause may be the change in function of the pelvic fin from that of a true fin to that of a mere organ for attack or defence. The pectoral fin has therefore to perform the combined functions of the two pairs.

In view of the phylogenetic shifting forwards of the pelvic fin in Teleosts, it would be instructive if some worker with a large series of types at his disposal would ascertain if there is a corresponding phylogenetic shifting back of the pectoral fin. At present I can find no explanation of the fact that the fin shifts most rapidly just at those points in the ontogeny where my collection of specimens is poorest.

A further study of figs. 2-4 suggests that the range of variation in the position of this fin increases as life advances. In the first group the range is 8 per cent., in the second 9 per cent., in the third 13 per cent.